

### **REMARKS/ARGUMENTS**

Claims 1-3, 5, 7-8 and 10-11 are pending herein. The PTO has withdrawn claims 5 and 7 from further consideration. Claims 1 and 8 have been amended as supported by Fig. 4 and paragraphs [0003] and [0031] in the specification, for example. Applicants respectfully submit that no new matter has been added.

Supervisory Examiner Meeks and Examiner Turocy are thanked for courtesies extended to Applicants' undersigned representative during a telephonic interview on August 3, 2010. The substance of that interview has been incorporated into the following remarks.

1. The rejection of claims 1-3, 8 and 10-11 under §112, first paragraph is noted, but deemed moot in view of the amendments to claims 1 and 8 in the amended claim set submitted above and the literature articles submitted herewith. The three literature references discussed during the telephonic interview are attached. These references show that one of skill in the art would understand that the claimed main peak wave number and shoulder peak wave number are characteristics of amorphous diamond like carbon (DLC). During the interview, the Examiners agreed that "amorphous" DLC is inherently disclosed in the present application, the opposing electrodes being "free from any coating" limitation is supported by Fig. 2 and paragraph [0009], and that the amendments to the claims would overcome the pending §112 rejection.

2. Claims 1-3 and 10 were rejected under §103(a) over Yara alone or in view of Hartmann and Awazu; and claims 1-3, 8 and 10-11 were rejected under §103(a) over Yara in view of Mizuno. To the extent that these rejections may be applied against the amended claims, they are respectfully traversed.

Amended claim 1 recites a method of producing a thin film using opposing first and second electrodes, the method comprising the step of applying a pulse voltage on the opposing electrodes under a pressure of 100 to 1600 Torr in an atmosphere consisting of a carbon source gas and helium gas to generate discharge plasma so that a thin film, comprising diamond like carbon that is amorphous diamond like carbon having a Raman spectrum comprising a main peak at about a wave number of 1580  $\text{cm}^{-1}$  and a shoulder peak in a wave number range of 1300  $\text{cm}^{-1}$  to 1500  $\text{cm}^{-1}$ , is formed on a substrate. The pulse voltage is an impulse voltage and has a pulse duration shorter than 1000 nsec and the opposing first and second electrodes are free from any coatings. Independent claim 8 has been amended in a similar manner.

Yara discloses a method for producing thin carbon films at a low temperature in an atmosphere containing carbon and oxygen and/or hydrogen under a pressure near atmospheric pressure. The PTO relies upon Hartmann and Awazu for disclosing diamond like carbon films having a Raman spectrum allegedly near the claimed wave numbers. The PTO relies upon Mizuno for allegedly disclosing an ultra short pulse discharge plasma for forming diamond like carbon thin films under low or vacuum pressure conditions.

Amended claims 1 and 8 are distinguishable from the cited references for at least the following reasons.

First, Yara specifies that at least one of the opposing electrodes is covered with a solid dielectric film to stably generate the plasma and deposit the DLC film. Further, Yara also discloses that if neither electrode is covered with a solid dielectric film, an arc discharge will occur and the diamond like carbon film will not be produced (paragraphs [0014] and [0016] and claim 1). Mizuno also discloses that a portion of each electrode is covered by a ceramic insulator (dielectric material) (page 67). In contrast, amended independent claims 1 and 8 now clearly recite that the opposing first and second electrodes are free from any coatings. Awazu and Hartmann fail to overcome the deficiencies of Yara and Mizuno. Thus, the claimed method for producing a thin film is distinct from the cited references.

Second, the DLC film produced by Yara is crystalline DLC based on the Raman characteristic peak at  $1333\text{ cm}^{-1}$  and the many diamond grains observed (paragraphs [0052]-[0054]). More specifically, the PTO admits that Yara fails to disclose a DLC film having the claimed main peak and shoulder peak (Office Action at page 9). To overcome this deficiency, the PTO cites to Hartmann and Awazu for allegedly disclosing the claimed main peak at  $1580\text{ cm}^{-1}$  and the claimed shoulder peak in the range of  $1300\text{ cm}^{-1}$  to  $1500\text{ cm}^{-1}$ . However, in all of the examples of Hartmann, the Raman spectrum includes a main peak attributable to crystalline DLC at  $1310 - 1360\text{ cm}^{-1}$ , twin peaks attributed to amorphous carbon at  $1475$  and  $1548\text{ cm}^{-1}$ , and there is no disclosure of any other phase. In fact, as shown in Figs. 4A and B of

Hartmann, all of the main peaks of the crystalline DLC film are between 1310 and 1350  $\text{cm}^{-1}$  for all of the disclosed methane concentrations with the remaining twin peaks at 1475  $\text{cm}^{-1}$  and 1548  $\text{cm}^{-1}$  attributable to amorphous carbon, which is not a diamond like carbon peak (page 854, right column, lines 25-30). The twin peak configuration at 1475 and 1548  $\text{cm}^{-1}$  is a characteristic of amorphous carbon; amorphous diamond like carbon does not exhibit this twin peak characteristic. Awazu discloses a DLC film formed by hybrid pulse plasma coating system in which the Raman spectrum has a main peak around 1590  $\text{cm}^{-1}$  that is not substantially changed when the gas concentrations are varied. Thus, the claimed DLC film is structurally distinct from the crystalline DLC produced by the cited references.

Third, pulse durations disclosed by Yara is greater than the pulse duration of less than 1000 nsec. More specifically, Yara explicitly discloses pulse durations of 1000 nsec or greater. In contrast, amended independent claim 1 recites a pulse duration shorter than 1000 nsec and amended independent claim 8 recites pulse duration shorter than 500 nsec, which is less than half of the shortest duration cited in Yara.

During the interview, the Examiners stated that the proposed amendments helped clarify the patentable distinctions over the prior art, and that the three distinctions discussed above should overcome the pending rejections.

Based on the above, the cited references fail to teach or suggest each and every element recited in amended independent claims 1 and 8. Accordingly, Applicants respectfully request that Examiner Turocy reconsider and withdraw these rejections.

For at least the foregoing reasons, Applicants respectfully submit that all pending claims herein define patentable subject matter over the art of record.

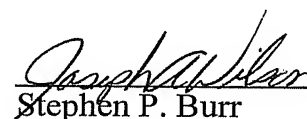
If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

August 11, 2010

Date

  
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Attachments:

- Nakahigashi, Takahiro "Usage of Extending Carbon Films Including DLC" Surface Science, Vol. 25, No. 2, 2004, pages 110-114 (5 pages).
- Saito et al. "Handbook of diamond-like carbon films" NTS, 6/2/2006 (8 pages).
- Yoshikawa, Masanori "Fundamentals of New Diamonds" 1991 (3 pages).

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